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AN UPDATED ERP SYSTEMS ANNOTATED BIBLIOGRAPHY: 2001-2005

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ABSTRACT

The goal of this study is to provide an updated annotated bibliography of ERP publications published in the main IS conferences and journals during the period 2001-2005, categorizing them through an ERP lifecycle based framework that is structured in phases. The first version of this bibliography was published in 2001 (Esteves and Pastor, 2001c). However, so far, we have extended the bibliography with a significant number of new publications in all the categories used in this paper. We also reviewed the categories and some incongruities were eliminated. Furthermore, we present topics for further research in each phase.

Keywords: Enterprise Resource Planning, ERP lifecycle, ERP publications, formats, references

I. INTRODUCTION

The goal of this study is to provide an updated annotated bibliography of ERP publications published in the main IS conferences and journals during the period 2001-2005, categorizing them through an ERP lifecycle-based framework that is structured in phases. The first version of this bibliography was published in 2001 (Esteves and Pastor, 2001c). However, so far, we have extended the bibliography with a significant number of new publications in all the categories used in this paper. We also reviewed the categories and some incongruities were eliminated.

This paper is organized as follows. First, we present the approach used to search for the articles. Then, we provide the bibliography and review. Finally, we draw some conclusions.

II. SURVEY SEARCH APPROACH

In order to develop an overview of academic activity relating to ERP systems, key IS conferences and journals were scanned for the period 2001-2005. Academic events surveyed are presented in Tables 1 and 2. For the period 2001-2005, the list of IS journals surveyed is based on the categorization of the ranking of IS journals developed by Mylonopolous and Theorakis (2001). Thus, we would like to point out that any subsequent analysis of ERP publications on this list of IS journals provided by Esteves and Pastor must be based on journals published after 2001, since it was only for this period that we were able to have an accurate collection of publications from said list.

Table 1. IS conferences surveyed within the period 1997-2005

IS conferences	
ACIS	Australasian Conference on Information Systems
AMCIS	Americas Conference on Information Systems
ECIS	European Conference on Information Systems
ECITE	European Conference on Information Technology Evaluation
EMRPS	Enterprise Management and Resource Planning: Methods, Tools and Architectures
HICSS	Hawaii International Conference on Systems Science
ICEIS	International Conference on Enterprise Information systems
ICIS	International Conference on Information Systems
IFIP 8.2	IFIP 8.2 - group information systems
PACIS	Pacific Asia Conference on Information Systems

The search was made using keywords such as enterprise resource planning, enterprise wide systems, enterprise systems or software packages, and the main ERP vendors such as: SAP, Oracle, Baan, Peoplesoft, JD Edwards. Publications during the period 2001-2005 were analyzed. Tables 3, 4 and 5 list the number of publications identified from conferences and IS journals. We also included relevant publications from other scientific publications we found during the collection process.

Table 2. IS journals surveyed within the period 1997-2005

IS journals	
AMR	Academy of Management Review
BPMJ	Business Process Management Journal
CACM	Communications of Association for Computing Machinery
CAIS	Communications of the Association for Information Systems
DB	Data Base
DS	Decision Sciences
DSS	Decision Support Systems Journal
EJIS	European Journal of Information Systems
HBR	Harvard Business Review
IEEEEC	IEEE Computer
IM	Information and Management
ISF	Information Systems Frontiers
ISJ	Information Systems Journal
ISM	Information Systems Management Journal
ISR	Information Systems Research

JGIM	Journal of Global Information Management
JIT	Journal of Information Technology
JMIS	Journal of Management Information Systems
JSIS	Journal of Strategic Information Systems
MISQ	Management Information Systems Quarterly
OM	Omega
OS	Organization Science
SMR	Sloan Management Review

Table 3. ERP publications at selected international IS conferences within the period 1997-2005

	1997	1998	1999	2000	Total	2001	2002	2003	2004	2005	Total	Σ
ACIS	-	2	1	1	4	0 ^(α)	7	8	8	10	33	37
AMCIS	1	2	32	29	64	28	18	12	11	21	90	154
ECIS	-	2	4	5	11	4	8	6	6	2	26	37
ECITE*	-	-	-	-	0	3	5	5	4	2	19	19
EMRPS	-	-	29	-	29	-	-	-	-	-	0	29
HICSS	-	-	3	3	6	6	5	7	6	7	31	37
ICEIS	-	-	-	-	0	3	4	6	14	10	37	37
ICIS	1	4	4	7	16	4	3	2	6	2	17	33
IFIP 8.2*	-	-	-	-	0	1	4	-	3	-	8	8
PACIS	1	-	-	3	4	6	6	6	11	7	36	40
Others	1	5	9	9	24	2	2	1	-	-	5	29
Total	4	15	82	57	158	57	62	53	69	61	302	460

(α): Information about ACIS 2001 is not available in library on-line of Association for Information Systems

Table 4. ERP publications at selected IS journals within the period 1997-2005

	1997	1998	1999	2000	Total	2001	2002	2003	2004	2005	Total	Σ
AMR*	-	-	-	-	0	-	-	-	-	-	0	0
BPMJ*	-	-	-	-	0	14	2	1	5	8	30	30
CACM	-	-	-	8	8	-	3	2	2	1	8	16
CAIS	-	-	1	1	2	1	2	2	-	1	6	8
DB*	-	-	-	-	0	-	-	-	-	-	0	0
DS*	-	-	-	-	0	-	1	-	-	-	1	1
DSS	-	-	-	-	0	-	-	-	-	1	1	1

EJIS	-	1	-	1	2	2	1	2	-	5	10	12
HBR	-	-	1	-	1	-	-	-	-	-	0	1
IEEEC*	-	-	-	-	0	-	-	-	-	-	0	0
IM*	-	-	-	1	1	-	2	3	3	-	8	9
ISF*	-	-	-	-	0	-	1	-	-	-	1	1
ISJ	-	-	-	-	0	-	3	1	1	1	6	6
ISM*	-	-	-	-	0	1	2	3	1	4	11	11
ISR	-	-	-	-	0	-	-	-	-	-	0	0
JGIM	-	-	1	-	1	-	1	-	-	-	1	2
JIT	-	-	2	6	8	1	1	-	1	-	3	11
JMIS	-	-	-	-	0	-	3	-	1	-	4	4
JSIS*	-	-	-	-	0	-	-	-	6	5	11	11
MISQ	-	-	-	-	0	-	-	1	-	2	3	3
OM*	-	-	-	-	0	-	1	1	2	-	4	4
OS*	-	-	-	-	0	-	-	-	-	-	0	0
SMR*	-	-	-	-	0	1	1	1	-	-	3	3
Others	1	3	2	4	10	5	5	24	2	-	36	46
Total	1	4	7	21	33	25	29	41	24	28	147	180

Table 5. Summary of ERP publications at selected international IS conferences and journals within the period 1997-2005

Total	1997	1998	1999	2000	Total	2001	2002	2003	2004	2005	Total	Σ
Conferences	4	15	82	57	158	57	62	53	69	61	302	460
Journals	1	4	7	21	33	25	29	41	24	28	147	180
Total Year	5	19	89	78	191	82	91	94	93	89	449	640

III. ERP BIBLIOGRAPHY ANALYSIS

After we collected all the publications, they were analyzed and categorized using the same ERP lifecycle used in the initial ERP annotated bibliography (Esteves and Pastor, 2001c). One of the ways to analyze qualitative data is the utilization of a classification system that includes a quest for regularity and standards, as well as topics encompassed by the data and that must then be summarized by means of words or phrases (Bogdan and Biklen, 1982). We used that process to analyze and categorize our data, the publications found in this case. The ERP lifecycle represents the various phases through which a project of an ERP system passes in an organization. The ERP lifecycle is structured in dimensions and phases, generic enough to permit the classification of publications and comprehensive enough to give a general vision of the whole ERP lifecycle. Publications that did not fall into a specific phase of the ERP lifecycle were included in an ERP general directions section.

The number of publications that are related to the implementation phase (47%) is notoriously greater than the number related to other phases as shown in Figure 1. This corresponds to the focus on ERP systems given by the trade press, which also deals predominantly with implementation problems. Due to the great number of papers related to education, we kept a section dedicated to that subject. We reviewed 449 publications, and almost 20% of them from AMCIS. So far, AMCIS is the academic event with more mini-tracks dedicated to ERP field. Conferences account for 67% of the ERP publications. Next, we describe in detail each one of the four sections and we present topics for further research.

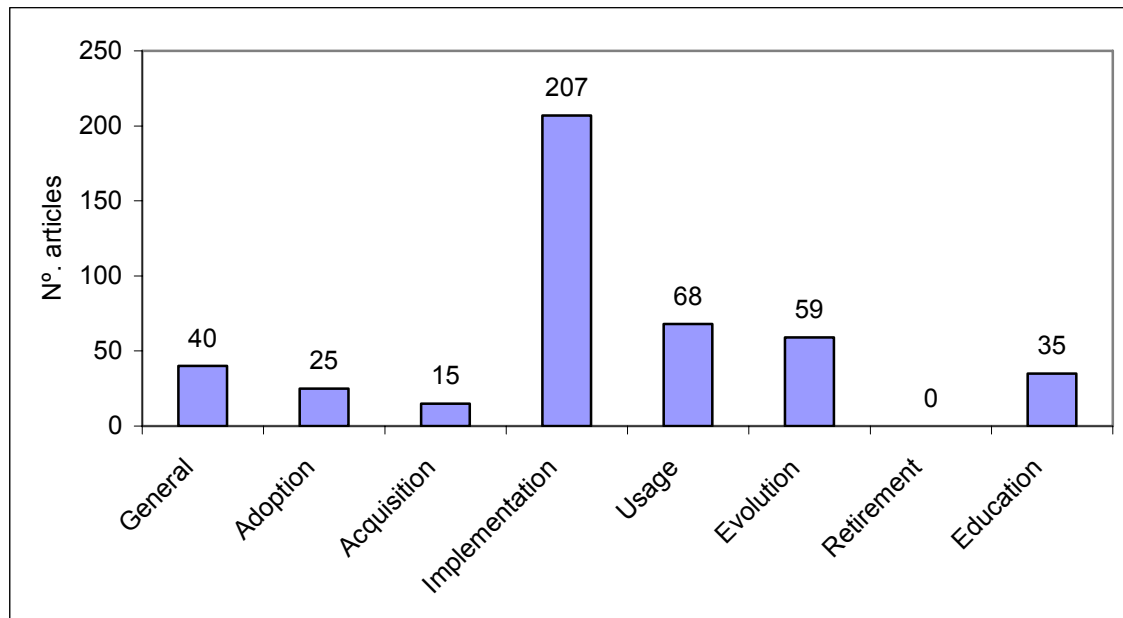


Figure 1. Number of Publications by category

GENERAL DIRECTIONS

We categorized the publications on ERP issues not related to ERP lifecycle phases in three main topics: research issues, business modeling, and ERP product development issues. Next, we describe each topic in detail.

Research Issues

This topic is related with ERP research issues and trends. It covers aspects such as: research agendas, ERP overview, motivations and expectations, proposals on how to analyze the value of ERP systems and how to deal or face ERP research projects.

- ERP systems research issues, overviews are analyzed in some publications, and some authors proposed research agendas (Esteves and Pastor, 2001c; Dong et al., 2002; Jacobs and Bendoly, 2003; Shehab et al., 2004).
- Carton et al. (2004) present a roadmap for researching how an ERP system changes the landscape for management decision-making, and therefore the effectiveness of the organization as a whole.
- Chng and Vathanophas (2002) build on Parr and Shanks (2000) to investigate the different phases of the ERP lifecycle, as well as the applicability of the lessons learned to an inter-organizational arrangement.
- Hawking and Stein (2001) present an analysis of the Australian ERP marketplace.

- Houghton et al. (2004) analyze previous research on SAP for evidences of systematic research biases to analyze if that is the cause for such lack of ERP implementation failure research.
- Ni et al. (2002) explore the issue of flexibility in ERP systems.
- Sammon and Adam (2002a) stress the importance of understanding the relationships between the main actors of ERP community, defined here as a triadic group composed of (1) an ERP vendor, (2) an ERP consultant and (3) an implementing organization.
- Sammon and Adam (2002b) discuss a model for investigating non-decision making in ERP communities.
- Sathish et al. (2003) begin with an overview of what constitutes an enterprise system. They also review stakeholder theory and how it can be used to better understand ERP systems within organizations.
- Wagner (2002) presents an end-to-end narrative approach that is particularly useful for describing, undertaking, and understanding process-oriented field research. She provides as an example an ERP study.
- Westrup (2002) uses the idea of management fashion as an example of a discourse based approach to discuss the rise and apparent demise of ERP systems.

Business Modeling

The objective of the business modeling process is to help an organization to define a good business vision that will reduce the effort of adopting the ERP business model. It helps organizations to understand, manage and communicate their business processes. It covers aspects such as: usage of modeling tools applied in ERP contexts, new business modeling approaches, and comparisons between them.

- Becker et al. (2003) propose a modeling language for the domain of enterprise information portals.
- Darras et al. (2003) show the use of the concepts of enterprise modeling, with formalism close to software engineering in order to ameliorate the analysis and the deployment of ERP systems.
- Dorp (2002a) describes the extension of ERP with recipe and material traceability and also discusses the functionality of tracking and tracing, proposing a general reference data model for tracking and tracing in manufacturing area.
- Dorp (2002b) describes the traceability requirements in manufacturing situations in natural language and he induces a general modeling solution: a reference data model.
- Hedman and Kalling (2002) illustrate how the management and business context of Information and Communication Technologies (such as ERP and CRM systems) can be viewed through the business model.
- Hedman and Kalling (2003) review business model concept and they propose an outline for a conceptual business model. The business model is illustrated by an ERP implementation in a European company.
- Mendes et al. (2003) include the concept of time in a novel business modeling framework they are developing to cope with the complexity of Modeling Business Change.
- Murthy and Wiggins (2004) critique prior data modeling approaches and present an integrated object-oriented modeling approach that captures both the structural and the behavioral aspects of the business domain.
- Soffer et al. (2003) present a generic reverse engineering process, aimed at obtaining a model of the ERP functionality, options, and supported business processes.
- Zoukar and Salinesi (2004) propose a matching method between an ERP functionality model and a business requirement model, and explain how the similarity model was developed in a systematic way.

ERP Product development Issues

This topic is related with the first-hand development and manufacturing of ERP products. It covers aspects such as: new modules, interfaces, componentization, increased flexibility and introduction of new emerging technologies and platforms.

- Andresen and Gronau (2005) develop a pattern-based approach which covers three identified dimensions of adaptability in ERP systems.
- Carlsson and Hedman (2001a, 2001b) attempt to evaluate enterprise portals focusing in an artifact and critical evaluation of the role based concept of mySAP workplace enterprise portal.
- Dreiling et al. (2005a) explore the product nature of software as proprietary item has been questioned through the rapid increase of open source programs that are being used in business computing in general, and also within the overall portfolio that makes up ERP systems.
- Frank (2001) proposes the use of a new distributed ERP system with approximated ACID properties as an E-commerce system.
- Loos (2001) proposes appropriated data structures for ERP application to solve a cyclic production problem, which is distinctive of recycling and chemical processes. Furthermore an approach is presented to handle by-products and cyclic production with common gozintograph structures.
- Marx and Rautenstrauch (2005) propose an architecture for a distributed ERP-system based on web-services and peer-to-peer-network technology whose roll-out and maintenance is better affordable for SMEs than traditional systems.
- Murphy and Seddon (2003) provide a model for understanding the motivations of ERP developers and customers in establishing close relationships.
- Neumann et al. (2002) suggest a model of integrated coordination of Production Planning and Control (PPC) systems, which are a subset of ERP systems, by means of Workflow Management Systems (WfMS).
- Ng and Ip (2003) propose a model called Web-based object-oriented model (WOOM) which provides the framework, channel, and interface necessary to build a Web-based ERP system in a global business environment.
- Reitwiesner et al. (2001) analyze the competition between framework technology and standard software on the basis of a market model which allows them to incorporate the impact of network effects and compatibility decisions onto the market positions of these two competing technologies.
- Stojanovic et al. (2001) propose a new systematic and integrated approach to component-based development of complex enterprise-scale, information systems.
- Taneja and Raja (2005)] explore the effect of chasm on the sustainability issues in ERP industry. The results demonstrate that efficient companies are not just investing more in R&D and Marketing, but are in fact managing the inputs better than the inefficient companies.
- Truex and Avison (2003) reflect on the genealogy of method engineering and look to how it must evolve to meet the needs of contemporary IS development, in particular ERP systems.
- Uwizeyemungu and Raymond (2004) outline what could be considered as an ERP by first determining the essentially required characteristics of such a system: integration, flexibility and transversality.
- Volkoff and Sawyer (2001) analyze the effects of intra-group conflict on ERP software development team performance using a path model with that relates three antecedents, the presence of intra-group conflict, and the level of conflict management to software development team performance.

Main Topics Researched

ERP systems overview, research agendas, and research issues were very well covered in the publications found. There is a growing number of publications related to business modeling, but

this area still needs more research and attention from IS researchers. The review shows that development of ERP products has been centered on technological issues, like component or web- based development systems and the characteristics of an ERP: integration, flexibility, and transversality. Nevertheless, other authors center on understanding the motivations of ERP developers and customers to establish close relationships between both.

Topics for Further Research

Unanswered issues such as ERP complexity, integration, and flexibility should be addressed in the future. Technologically, other issues of interest are the development of interfaces, componentization, and integration of technologies. The development of open source ERP systems is an emerging issue. The improvement of business modeling techniques, analysis of business models' fit, and adequacy of ERP systems to business models are also areas where there is a lack of research. There is also a need to evaluate the most adequate database models for ERP systems. It is also essential to study the relationship among the stakeholders during the ERP development process, how ERP vendors collect and define business best practices, how these practices are materialized in the ERP systems, and the relationship between user groups and ERP vendors. Open source ERP systems are emerging. Issues on how to improve these ERP are being developed, the definition of best practices within these open communities' relationships, and so on.

IV. ERPS ALONG THEIR LIFECYCLE

Here we use the ERP lifecycle framework proposed by Esteves and Pastor (1999). This framework is structured in phases, which consist of the several stages that an ERP system goes through during its whole life within the hosting organization. They are the following: adoption decision, acquisition, implementation, use and maintenance, evolution, and retirement phase. Next, we describe each phase:

- **Adoption decision phase.** This phase is the one during which managers must question the need of a new ERP system while selecting the general information system approach that will best address the critical business challenges and improve the organizational strategy. This decision phase includes the definition of system requirements, its goals and benefits, and an analysis of the impact of adoption at a business and organizational level.
- **Acquisition phase.** This phase consists of the product selection that best fits the requirements of the organization. Thus, minimizing the need for customization. A consulting company is also selected to help in the next phases of the ERP lifecycle especially in the implementation phase. Factors such as functionality, price, training, and maintenance services are analyzed and the contractual agreement is defined. In this phase, it is also important to make an analysis of the return on investment of the selected product.
- **Implementation phase.** This phase deals with the adaptation of the binomial ERP-organization. Thus, the customization or parameterization and adaptation of the ERP package acquired are made, according to the needs of the organization. Usually this task is made with the help of consultants who provide implementation methodologies, know-how, and training. Although training will be present in all the phases, the largest investment is made during the implementation phase.
- **Use and maintenance phase.** This phase consists of the use of the product in a way that returns expected benefits and minimizes disruption. During this phase, one must be aware of the aspects related to functionality, usability, and adequacy to the organizational and business processes. Once a system is implemented, it must be maintained, because malfunctions have to be corrected, special optimization requests have to be met, and general systems improvements have to be included.
- **Evolution phase.** This phase corresponds to the integration of more capabilities into the ERP system providing new benefits. The extensions can be classified in two

types: the first one is the evolution "upwards" with functionality oriented to decision making with applications such as advanced planning and scheduling, data-warehouses, and business intelligence systems; the second type is the evolution "to outwards" its environment, with applications such as customer relationship management, supply-chain management, inter-organizational workflow, and electronic commerce.

- **Retirement phase.** This phase corresponds to the stage when with the appearance of new technologies or the inadequacy of the ERP system or approach to the business needs, managers decide if they will substitute the ERP software with other information system approach more adequate to the organizational needs of the moment. Some organizations have just passed through this phase by several reasons such as: strategic changes, lack of trust in the ERP vendor, or the implementation partner and bad implementation experiences.

ADOPTION

Adoption Impact

- Beard and Sumner (2004) using the VRIO framework of the resource-based model of competitive advantage, explore whether ERP systems can provide an organization with a sustained competitive advantage.
- Hunton et al. (2003) examine the longitudinal impact of ERP adoption on firm performance by matching 63 firms with peer firms that had not adopted ERP systems.
- Suh and Kym (2001) examine the impact of absorptive capacity on ERP adoption of the firm. The study proposes several variables have to be considered for effective knowledge acquisition for practitioners.
- Tagliavini et al. (2002) analyze the impact of the level of business complexity and the extent of organizational SME in ERP adoption.

Adoption Approaches

- Arunthari and Hasan (2005) contribute to the literature of the adoption of ERP systems in developing countries. Their study has led to the development of a research model of ERP system adoption.
- Chang et al. (2003) employ Transaction Costs Economics (TCE) and Institutional theory to provide a theoretical foundation to better explain the extent of ERP adoption within companies.
- Light et al. (2001) analyze the differences between best-of-breed approach and a single vendor-based ERP approach.
- Ng and Tan (2004a, 2004b) employ symbolic interactionism in an ethnographic study for comparing ERP packages and legacy systems.
- Oliver and Romm (2002b) present a critical approach for exploring the themes of communication, rationality, and domination in the context of ERP adoption.
- Raymond et al. (2004) identify the dimensions of SMEs' readiness for the adoption of ERP systems.
- Spathis and Constantinides (2004) examine the underlying reasons why companies choose to convert from conventional IS to ERP systems and the changes brought in, particularly in the accounting process.
- Tan et al. (2004) compare the adoption of an ERP commercial package and an ERP development in-house to decipher how ERP adoption can be strategized to develop strategic capabilities and understand the implications of both approaches.

Challenges and Enablers

- Bagchi et al. (2003) evaluate the user participation and involvement in the context of ERP systems. They do an examination of ERP system adoption at the individual or user level and find differences in nature of user participation and involvement in ERP.

- Behrens and Sedera (2004) provide a theoretical framework which reveals that the causal factors found in the categories of technology, organization, business procedures and people contribute to the phenomenon of shadow systems in an ERP context.
- He (2004) introduces a Resource-Based Perspective (RBP) model on ERP challenges to help make ERP decisions in China.
- He and Brown (2005) investigate which issues facilitate or hinder the adoption of ERP applications in China in the light of previous research reported on Western firms.
- Hung et al. (2004b) conduct a theoretical model to explore the critical factors which have influence on ERP adoption in Taiwan's SMEs.
- Laukkanen et al. (2005) investigate the relationship of enterprise size to the constraints and objectives of ERP systems adoption.
- Light and Papazafeiropoulou (2004) use the theory of diffusion of innovations to develop a greater understanding of the principal attributes of ERP packages adoption.
- Oliver and Oliver (2002) present a discourse analysis of an extract from an electronic newsletter, which was disseminated to staff by the vice-chancellor of a regional Australian university, announcing the adoption of an ERP system.
- Papazafeiropoulou and Light (2004) look at IT diffusion and adoption in terms of technology, organizational aspects and inter-organizational aspects in order to see who might be the real beneficiaries of ERP adoption.
- Pozzebon (2001) dealing with ideas borrowed from structuralist and social constructivist streams of thinking, identifies occasions of ERP package negotiation and change at three levels: segment, organization, and individual level.
- Stevens (2003) proposes three main resources: standards, ERP software, and middleware in order to processing plants adopt ERP successfully.
- Wei and Wang (2004) draw upon data from two cases to understand the change dynamics and the misfits of adopting an ERP system from a stage view.

Main Topics Researched

The research in this phase has focused on how some types of organizations have adopted ERP systems and the requirements, risks, benefits, and critical factors associated. Some studies have analyzed the factors and challenges for ERP adoption in different contexts, other studies have analyzed the difference between best-of-breed approach and a single vendor-based ERP approach or the comparison of the adoption of an ERP commercial package and an ERP development in-house. Some studies examine the underlying reasons why companies choose to convert from conventional IS to ERP systems and investigate the relationship of enterprise size to the constraints and objectives of ERP systems adoption. Finally, others evaluate user participation and involvement in the context of adoption of ERP systems.

Topics for Further Research

Some researchers have stressed the need to create methodologies that help managers to assess why an ERP approach is the most adequate for a specific organization and why the current information system should be substituted. There is a lack of studies that analyze how this decision adoption is made in ERP context. Most of the organizations are also dealing with the problem of a single vendor versus best-of-breed solutions and ERP vendors are also providing integration technology for their ERP systems. Few studies have analyzed this topic and have examined the benefits, impact and long-term of these kind of solutions. Lately, SMEs are also adopting ERP systems and there is a need to understand the ERP adoption in this context compared with large companies. It would be interesting to compare studies made in different countries to verify that conceptual models can be generalized on a global scale. There is also a need to understand ERP vendor strategies, how they are evolving to deal with this new type of clients.

ACQUISITION

Acquisition Approaches

- Axelsson and Avdic (2001) discuss the role of IT Management during the Acquisition of ERP Systems.
- Baki and Çakar (2005) analyze how to define the criteria for the ERP selection process and what criteria are the most important for firms.
- Bernroider and Koch (2001) analyze the differences in characteristics of the ERP system selection process between small, medium, and/or large sized enterprises.
- Hallikainen et al., (2002) investigate the criteria that are emphasized when making decisions on acquiring ERP software packages by Finnish SME.
- Hallikainen et al. (2004) synthesize and categorize the reasons for ERP acquisition into technological and business reasons.
- Nelson (2005) explores affect and emotional reactions from the perspective of the different stakeholders involved the ERP selection. The results show that ERP selection is a very emotional phase.
- Rosemann et al. (2004b) suggest the optimization of requirements analysis, and thus improved alignment by formalizing analyses of both organization's requirements and enterprise system's capabilities with the Bunge–Wand–Weber (BWW) ontology.
- Sammon et al. (2001) document the early stages of a larger research study which is currently in progress into the selection process that organizations should follow when investing in ERP systems.
- Stefanou (2001) proposes a framework of the key issues involved in the ERP selection process and the associated costs and benefits.
- Sundarraj and Talluri (2003) propose a multi-period integer-programming model to assist decision-makers in the procurement of componentized enterprise information technologies.
- Verville (2002) describes a case study of ERP acquisition that illustrates good practices on ERP acquisition and sets forth a framework for the ERP acquisition process.

Acquisition Evaluation

- Chen (2001) analyzes several critical planning issues including needs assessment and choosing a right ERP system, matching business processes with the ERP system, understanding the organizational requirements, and economic and strategic justification.
- Sarkis and Sundarraj (2001) propose a quantitative technique called the Analytical Hierarchy Process (AHP) for strategic evaluation of enterprise Information technologies such as ERP systems.
- Sneller et al. (2004) propose a method for ex-ante evaluation of ERP that is generally applicable in small and medium sized distribution and manufacturing companies.
- Rosemann et al. (2005) discuss why ERP selection and implementation is still being perceived as problematic, if not risky. Then, they present an updated view of current practices of ERP selection and implementation.

Main Topics Researched

The research in this area has focused on ERP selection methods, criteria, and best practices affecting ERP selection. Some authors synthesize and categorize the reasons for ERP acquisition into technological and business reasons. The studies analyze several critical planning issues including needs assessment and choosing the right ERP system, matching business processes with the ERP system, understanding the organizational requirements, and economic and strategic justification. Some studies have proposed models to evaluate the benefits of ERP acquisition in different contexts like SMEs, while others have explored effects and emotional reactions from the perspectives of the different stakeholders involved in the selection of an ERP package.

Topics for Further Research

The analysis of return on investment and different price models in ERP acquisitions is still at an early stage. There is also a need to further study the role of each party (vendor, customer, and consultant) and their influence on ERP selection. Also, the critical issues of defining a request for proposals and the contractual agreement need to be addressed. There is a need for studies that attempt to understand best practices in contract management and how contractual management may impact the future of the ERP system within the organization. Finally, there is a need to understand how companies are analyzing the technical infrastructure needed for the new ERP system. Usually, the acquisition of an ERP system entails changing the hardware and software in an organization, and most organizations forget to take this into account in the acquisition phase. Finally, there is a lack of studies that attempt to analyze the consultant process selection.

IMPLEMENTATION PHASE

The publications related with the implementation phase were categorized in five main topics: implementation approaches, implementation success, other implementation issues, organizational issues, and knowledge management issues as shown in Figure 2. Next, we describe each topic.

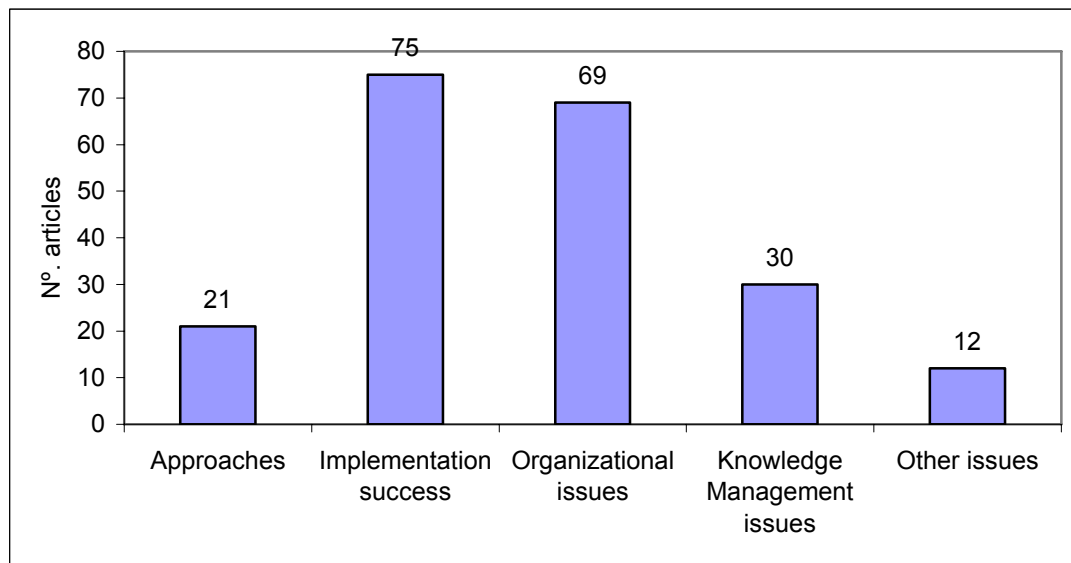


Figure 2. Number of publications related with each topic of implementation phase.

Implementation Approaches

This topic focuses on how to deal with an ERP implementation project. It covers aspects such as: taxonomies of ERP implementations, implementation strategies, methods and techniques, and comparisons with other software implementation projects.

- Al-Mudimigh and Jarrar (2001) propose a methodology for an ERP integrated approach.
- Arinze and Anandarajan (2003) develop the Enterprise Object Model (EOM) framework and mapping method for capturing user requirements in general terms, transforming them into detailed configuration settings for ERP software.
- Brehm et al. (2001) propose a typology of ERP tailoring types that go from configuration to modification of the ERP package. They also discuss the different implications of each choice.

- Chang and Gable (2001) confirm the importance of this finer partitioning of the data and distinctions identified reflect the circumstances of ERP lifecycle implementation, management and support among the stakeholder groups.
- Chang (2004) attempts to empirically identify and explicate the issues and concerns for individuals substantially involved with the SAP financial system within the government agencies. A repeatable methodology is also developed.
- Clemmons and Simon (2001) combine the concepts of control and coordination and Bartlett and Ghoshal topology of firm strategy to create a firm strategic orientation which is then matched to an ideal ERP configuration.
- Dreiling et al. (2005b) propose a method to increase the efficiency of ERP Systems implementations. They describe a business example using SAP modeling techniques to illustrate the proposed method.
- Esteves and Pastor (2002a) propose a framework to analyze the most critical ERP implementation processes (work packages).
- Fitz-Gerald and Carroll (2003) investigate the role of governance in ERP systems implementations.
- Reimers (2003b) describes how an ERP system implementation may support the transformation of a traditional management system.
- Rosemann (2001) focuses on the ERP system configuration. A main activity within this process is the configuration of reference models which support the specification of requirements related to ERP Systems.
- Rosemann et al. (2004a) provide an approach to evaluate the significance (size) of a gap between the world of organizational requirements and the world of system capabilities.
- Sato and Hori (2002) develop a quick iterative process prototyping for project management that shows necessary things to evaluate in the development of a business process within an ERP system.
- Stender (2002) describes AI2M - Agile Incremental Implementation Methodology - an incremental implementation methodology for ERP systems.
- Soja (2005) analyzes the conditions for ERP implementations and how ERP projects affect enterprise strategy.
- Somers and Nelson (2004) analyze the fit between information theory approach, in the current literature, and the experiences reported by a cross-section of 116 organizations that completed an ERP system implementation experience.
- Souza and Zwicker (2001) identify and analyze aspects of ERP systems usage and they build a theoretical model representing ERP systems' implementation process.
- Volkoff (2003) describes a teaching case that deals with the challenges inherent to an ERP system configuration.
- Wagner and Antonucci (2004) investigate the area of public and private sector ERP implementations and found that much of the private sector implementation methodologies and best practices are similar to public sector implementations.
- Wagner et al. (2004) use narrative research to analyze the negotiation of a best practice design during an ERP implementation.
- Wood and Caldas (2001) analyze the reasons for reductionism thinking during ERP implementations. They argue that by applying complex thinking we may open new avenues to explain these processes.

Implementation Success/Failure

Implementation success deals with the issues of how to succeed through an ERP implementation. It covers aspects such as: ERP project success and failure definitions, problems and outcomes, critical success factors, and risk management.

- Various authors have analyzed critical success factors and their relevance along the ERP implementation phases (Somers and Nelson, 2001; Esteves and Pastor, 2001a, 2001b, 2003, 2004; Nah et al., 2001b; Murray and Coffin, 2001; Akkermans and

Helden, 2002; Al-Mashari et al., 2003; Brown and Vessey, 2003; Nah et al., 2003; Umble et al., 2003; Bradley, 2005; Ward et al., 2005).

- Al-Mashari and Al-Mudimigh (2003) describe a case study of an ERP failed implementation to re-engineer the business processes of a major manufacturer.
- Al-Mudimigh et al. (2001) propose an integrative framework for ERP implementation based on an extensive review of the factors and the essential elements that contribute to success in the context of ERP implementations.
- Al-Mudimigh and Al-Mashari (2002) investigate the potential value of ERP implementation.
- Allen et al. (2002) investigate whether ERP systems offer a feasible IS strategy for higher education institutions using a critical success factor model.
- Amoako-Gyampah (2004) compares ERP critical success factors from a managerial and end-user perspective.
- Barker and Frolik (2003) analyze the trials and tribulations of an ERP implementation failure and offer suggestions for other organizations.
- Bradford and Florin (2003) use diffusion of innovation theory and IS success theory to develop and test a model of ERP implementation success.
- Caruso and Marchiori (2003) discuss the introduction of Information and Communication Technologies (like ERP) into SME and how, in this context, it is possible to manage the change process needed to really get the potential benefits of these technologies.
- Colmenares (2004) studies the critical success factors affecting ERP implementations in Venezuela.
- Esteves and Pastor (2002b) show the interdependence between the project sponsor role, project manager role, and ERP project success for which they present an interdependence model.
- Esteves et al. (2002a, 2002b, 2002c) propose a set of metrics for monitoring business process redesign, sustained management support, and training using Goals/Questions/Metrics method.
- Esteves et al. (2003) propose a Partial Least Squares (PLS) model to establish the relationships between critical success factors in ERP implementations.
- Faverio et al. (2005) discuss the critical success factors in ERP implementations within SME. They proposed a methodology to support the SME entrepreneur in identifying the critical factors to be monitored along the whole ERP adoption process.
- Ferrario and Montagna (2004) present a framework that allows estimating the difficulties of an ERP implementation project.
- Foster et al. (2004) look into the change management practices of Australian companies and identify the main success factors and barriers associated with effective management strategies in ERP implementations.
- Gargeya and Brady (2005) investigate and analyze common circumstances that occur within most ERP projects and determine the areas that are keys to success versus those that contribute to failure.
- Gefen (2002) analyzes the influence of client trust in the customization of ERP systems on their perception of engagement success.
- Grossman and Walsh (2004) examine some of the issues that need to be considered when traveling down the ERP path and discusses technical, operational, and legal issues.
- Halonen and Paavilainen (2005) describe how a hierarchical accident model is a suitable framework when modeling information system failures.
- Hong and Kim (2002) analyze the influence of ERP organizational fit and certain implementation contingencies in ERP implementation success.
- Kim et al. (2005) identify the critical impediments that large organizations face in the implementation of ERP systems and the impact of these impediments on overall success of ERP projects.

- Lech (2004) describes a process of maximizing the return on investment in ERP implementations by following the 80/20 rule: 80% of effort goes into developing functionality supplying 20% of business value.
- Lee and Myers (2004b) investigate how conflicts over strategy can affect the success of ERP implementations.
- Liang et al. (2004) examine cases of failed ERP system implementations in China and explaining the unique circumstances.
- Mabert et al. (2003b) investigate and identify key differences in the approaches used by companies that managed their ERP implementations on-time and/or on/under budget versus the ones that did not.
- Magnusson et al. (2004a, 2004b) propose a conceptual framework for forecasting ERP implementation success and discuss the role of such a framework in a software based tool.
- Mandal and Gunasekaran (2003) analyze some experiences of a successful ERP implementation in a water corporation and they provide suggestions for other organizations.
- Martinsons (2004) discusses how the same software system implementation can produce fundamentally different results.
- Nah et al. (2005) use the grounded theory approach to inductively develop a model that highlights key factors influencing end-users' acceptance of ERP systems, because the success of ERP implementation depends on the intensity and nature of its use by end-users.
- Nelson and Somers (2001) evaluate the applicability and effectiveness of the End-User Computing Satisfaction (EUCS) and assess the role of user training and knowledge for ERP system success.
- Newell et al. (2005) identify the socio-political and cultural issues that explain why this is difficult and suggest some meta-level processes (induction, informality, and improvisation) that can help to offset the problems with maintaining the critical success factors.
- Newman and Westrup (2005) analyze successful practices in ERP implementations. They conclude that making an ERP system work is more than an issue of technical expertise or social accommodation.
- Oana (2005) compares the financial performance trend of successful and less successful ERP implementers over three years following the implementation. This study reveals no significant contribution of the implementation effort to the success of ERP implementations.
- Rajagopal and Tyler (2002) identify the factors of influence to implement Oracle ERP systems and the performance of these systems.
- Ramírez and García (2005) present an explanatory model of ERP systems success and its empirical validation in a group of Chilean organizations.
- Reimers (2002, 2003a) attempts to identify the crucial implementation process and context variables which warrant closer attention in the study of IT-enabled organizational change. The author focuses his study in a Chinese context.
- Reinhard and Bergamaschi (2001) propose the measures for ERP project success efficiency and effectiveness that are used to evaluate the importance of success factors in each ERP project phase.
- Rosemann et al. (2001) report on an empirical investigation of the factors that influence process modeling success in ERP Systems.
- Scott and Vessey (2002) propose a model of risk factors in ERP implementation and illustrate the relationships and the trade-offs inherent in the model using two case studies.
- Shang and Seddon (2003) examine the risks and the sources of risks of process changes associated with ERP implementations.
- Sheu et al. (2004) review several issues critical to the success of international ERP implementations. They suggest that language, culture, politics, government

regulations, management style, and labor skills impact various ERP implementation practices at different countries.

- Skok and Legge (2001) use an interpretative approach to understand the reasons for the apparent lack of ERP success by analyzing issues raised by representatives of key stakeholder groups.
- Smyth (2001a) uses an a priori ERP Success Model based on a framework developed to explain success in the adoption of CASE packages.
- Soja (2004) studies the critical success factors affecting ERP implementations in Poland.
- Soja and Put (2005) attempt to discover the most desired attributes of a model of an ERP implementation project.
- Sullivan and Beach (2002) propose a conceptual framework to facilitate a study of the factors that determine success and failure among High Reliability Organizations (HRO's) and ERP system projects.
- Sumner and Hamilton (2005) in a case study of an ERP project within a Fortune 100 company in the transportation industry identify the strategies which facilitate a turnaround ERP project.
- Tan and Pan (2002) propose a preliminary framework for evaluating ERP system success using focus groups method.
- Timbrell and Chan (2003) using a Delphi study analyze the issues underlying the implementation of ERP systems in government agencies.
- Trienekens et al. (2005) report Critical Success Factors (CSF) in two ERP implementation projects in industry. The paper identifies both (dis)advantages of CSFs and shortcomings of ERP implementation project management.
- Wang and Chen (2002) derive a practical understanding of critical factors of dyad parties and whether their consulting process will improve ERP system quality.
- Wong et al. (2005) examine the current literature concerning ERP implementation problems during ERP implementation phases and causes of ERP implementation failure.
- Wu and Wang (2002) investigate ERP key-user satisfaction in the specific context of implementing an ERP system by an external contractor.
- Yang and Seddon (2004) analyze benefits and key project success factors from sixty ERP implementations discussed by senior project managers in some of the world's largest corporations at the June 2003 Sapphire conference.
- Zhang et al. (2002) examine generic and specific-to-China factors that affect ERP implementation success in China.
- Zhang et al. (2003a, 2003b) study the critical success factors affecting ERP implementations in China with focus on both generic and unique factors.

Organizational Issues

This category focuses on issues of people skills, know-how, organizational processes, structure, and culture, issues that end up changing in order to face a new ERP context.

- Aladwani (2001) describes an integrated, process-oriented approach for facing the complex social problem of workers' resistance to ERP.
- Amoako-Gyampah and Salam (2004) present an extension to the technology acceptance model (TAM), evaluate the impact of one belief construct, and two ERP implementation success factors (training and communication) on the perceived usefulness and perceived ease of use during ERP implementation.
- Andoh-Baidoo and Ngwenyama (2005) reformulate SSM to incorporate emancipatory ideals to enhance project communication during ERP implementation.
- Arif et al. (2005) analyze whether an ERP implementation is an information systems effort performed to support the business processes, or if it is a process re-engineering effort required to implement the ERP system.

- Berente (2005) presents a view of ERP systems as an amplifying technology that has the potential to amplify either adaptive or creative response, depending largely on firm-specific factors.
- Binbasioglu and Winston (2002) identify and distinguish the manifest and latent effects of an ERP system using a systems dynamic approach.
- Boersma and Kingma (2005a) develop an analytical framework through which the organizational cultural dimension of ERP implementations can be analyzed.
- Boersma and Kingma (2005b) focus on the mutual shaping of technology and organizational culture, in particular the virtualization of the organization.
- Cadili and Whitley (2005) explore the interpretative flexibility of ERP systems through the study of a project to implement a hosted system for the Central Accounting Department of a large multinational.
- Calvert and Carroll (2005) examine end-user training (EUT) in ERP systems with the aim of identifying whether current EUT research is applicable to ERP systems.
- Cao and Rahmati (2005) examine the impact of human and management organizational subsystems on business process change and performance. The findings of this study prove the importance of soft aspects in business process change through implementation of ERP systems.
- Carton and Adam (2003a, 2003b) investigate the impact of ERP roll-outs in multinational companies.
- Chertouras and Chatzikallia (2004) discuss the application of ERP in the reengineering of the business processes of a human resources department, which lead to a significant productivity enhancement.
- Chou et al. (2004) investigate how charismatic leadership style and intragroup conflict affect ERP implementation team performance.
- Davenport et al. (2004) examine the change management process associated with ERP implementations and they suggest that process change is being undertaken on an ongoing basis.
- Davison (2002) describes some lessons learned from ERP implementation experiences worldwide with different cultural heritages showing that there is the need from developers and consultants to adapt their products and services for different cultural markets.
- Dong (2001) proposes a conceptual model exploring impacts of top management on ERP implementation effectiveness.
- El Amrani et al. (2003a, 2003b) study the relationships between the factors influencing the ERP lifecycle, the perception of a more cross-functional overview of the company, and, more globally, the scope of the change this technology brings within the company.
- Elbanna (2003) explores some of the social and organizational obstacles that face the implementation of an integrated ERP system.
- Fitz-Gerald and Carroll (2005) present an analysis of the role of organizational governance in ERP-driven business transformation.
- Gefen (2004) examines how trust is built during an ERP implementation and the relative weight of this trust compared with the perceived qualities of the implemented ERP itself in determining clients' assessment that the business relationship with the vendor is worthwhile.
- Helm et al. (2003) discuss the importance of assessing employee attitudes throughout the ERP implementation process.
- Huang et al. (2001a) suggest that an ERP implementation is a social and emotional process termed as emotional buy-in through which stakeholders are transformed from being distant from the project to being part of the project.
- Hwang (2005) investigates ERP adoption and implementation issues of ERP systems based on the organizational IS management perspectives.
- Ke and Wei (2005) theorize how leadership affects ERP implementation through fostering the desired organizational culture, in addition to its direct effect.

- King (2005) draws some conclusions that may be helpful to managers who must select consultants and conduct joint ERP implementation efforts with them.
- Knapp and Shin (2001) look at the organizational impacts from a business performance point of view, seeking answers to how organizations evaluate ERP system implementations.
- Koch (2001) analyses ERP as a tool for realizing BPR in manufacturing. It combines theories from organizational sociology and management with technology-analysis.
- Kræmmergaard and Rose (2002) investigate the managerial competences required for the complex interactions required to successfully integrate an ERP system into an organization—the ERP journey.
- Kumar et al. (2003) identify a number of critical management challenges in ERP implementation activities.
- Legare (2002) illustrate the important role that organizational factors play in realizing the business benefits of an ERP implementation.
- Liang and Xue (2004) from an ERP vendor's perspective, analyze what can be done to address contextual issues relating to ERP implementations in SME.
- Lind (2005) develops some characteristics of process-oriented information systems. These characteristics are based upon socio-instrumental actions as the basic unit of analysis for information systems and business processes.
- Mabert et al. (2003a) analyze the impact of organization size on ERP implementations in the U.S. manufacturing sector.
- Madapusi and D'Souza (2005) analyze how misalignments between the firm's ERP system and its international strategy can often result in unsuccessful ERP implementations and sub-optimal business performance.
- Madhavan and Theivananthpillai (2005) explore the nature and process of business process redesign efforts of an organization that had successfully implemented an ERP solution.
- Matsui (2002) suggests that production information systems depend on certain organizational settings and quality management practices.
- Melin (2003) argues that ERP systems take the part of an organization's administrative paradox (flexibility vs. stability).
- Nandhakumar et al. (2003) examine the process of change enacted during the implementation of an ERP system over time.
- Nandhakumar et al. (2004, 2005) seek to understand the ERP implementation process, in particular, the link between the ERP implementation process and the underlying and often subtle influences within the context.
- Pozzebon and Pinsonneault (2004, 2005) analyze the critical influences that affect initial organizational decisions between internal members and external consultants on the global - local negotiation that characterizes ERP packages implementation.
- Rajagopal (2002) conducted an analysis of six manufacturing firms that implemented an ERP system and using the six-stage model proposed by Kwon and Zmud identifying various contextual factors that influenced these firms to implement ERP.
- Reimers (2004) illustrates the cultural issues implicated in the use of an ERP system in a medium size company operating in an emerging market economy.
- Rodecker and Hess (2001) investigate end-user computing satisfaction (EUCS) with an ERP system. This study differs from prior IS research on EUCS in that it focuses on ERP and it incorporates training, knowledge and involvement, and locus of control.
- Rose and Kræmmergaard (2002) construct a new theoretical model to understand the change of sense making in ERP implementations.
- Rowe et al. (2005) show that flexibility, the primary goal of ERP adoption, as well as implementation strategy factors (organizational vision, speed, and core modules) exerts a positive impact on cross-functionality in SME but not in large firms.
- Sarker and Lee (2003) test the role of three key social enablers in ERP implementations.

- Sawyer and Southwick (2002) analyze temporal effects in information and communication technology-enabled organizational change.
- Scott (2004) proposes an ERP innovation model based on innovation literature and an ERP case study.
- Shakir and Viehland (2004) examine ERP implementation business drivers in the new millennium and reflect on future directions for ERP adoption.
- Shang and Su (2004) analyze the reasons for user resistance, recognizing related user behaviors and actions, and identifying effective strategies to manage these changes involving two types of major users ERP systems.
- Shang (2005) assesses the alignment between international organizational operations and ERP systems configuration. Different aspects of the impacts on both head office and local units are then analyzed.
- Sia and Soh (2002) propose a framework that seeks to assess the severity of misalignment between ERP features and organizational requirements have resulted in costly workarounds by critically examining the seductive universal best practices embedded in ERP.
- Silveira and Diniz (2003) discuss the relation between IS implementation and organizational change processes. Two approaches were defined for this relation: technological and organizational.
- Soh and Sia (2004) explain package-organizational misalignments as the result of differences between the structures embedded in the package and those embedded in the organization.
- Southwick (2002) document the business process reengineering effort within a university that tries to develop a culture of enterprise thinking to align the organization with the ERP.
- Strong et al. (2001) explore the way ERP systems add structure to organizations and the various user responses, including workarounds, which result under varying conditions of task interdependence, complexity, and level of worker autonomy.
- Strong et al. (2003) use Grounded Theory method to develop a framework of the changes in control and visibility in ERP implementations.
- Tansley et al. (2001) focus on one stimulus to transformational change into development of Human Resource Information Systems as an opportunity structure that can enable a break with the past to facilitate a greenfield HR philosophy and enable a more strategic role for HR specialists.
- Van Stijn and Wensley (2005) conceptualize ERP's best practices in terms of organizational routines which are considered to be "repositories" of organizational memory.
- Vilpola and Väänänen-Vainio-Mattila (2005) propose conducting contextual analysis, committing end users in the ERP implementation team, and employing usability principles and processes in order to consider the human factors in ERP implementations.
- Volkoff et al. (2002) examine the differences between the way organizational units want to conduct their processes and the way ERP software functions.
- Wagner and Newell (2005) look at contentious episodes experienced during an ERP implementation to illustrate the difficulty of trying to always achieve common aims and illustrate the way in which reciprocity helped to move the project forward at these points of conflict.
- Wenger et al. (2005) interpret the dimensions of power in ERP implementations and they concluded that an ERP causes a great shift of power within the firm, but it should not be considered the main driver of the episodic power shift.
- Wu and Wang (2003) using a survey, analyze some ERP issues such as implementation development, package selection, and user satisfaction, in Taiwan. They present a comparative analysis of large size enterprises vs. medium size enterprises.

Knowledge Management Issues

This category covers aspects knowledge management, learning, and managing competencies from a people perspective and the identification and management of knowledgeable artifacts from an information management perspective. We found several studies that cover knowledge management issues such as:

- To understand the nature, structure and process of knowledge integration that occurs during ERP implementation [Pan et al., 2001; Newell et al., 2002a; Huang et al., 2001c].
- Bo and Gee-Woo (2004) develop a model of ERP success antecedents from the knowledge transfer, IT implementation, and innovation diffusion literatures.
- Butler and Pyke (2003) study the effects that ERP systems have on firm-specific intangible assets, such as firm-specific knowledge and core capabilities.
- Chan and Rosemann (2001, 2002) propose a framework for managing knowledge in ERP Systems. The framework draws its strength from meta-case studies and comprehensive literature analyses which are consolidated into a three-dimensional framework.
- Fadel et al. (2005) present a framework for understanding Process Knowledge Change in ERP system Implementations.
- Huang et al. (2001d) attempt to understand the nature and processes of knowledge integration that occur during ERP implementation.
- Jones (2001) examines how firms are able to effectively share knowledge across diverse functions and perspectives during ERP implementation.
- Jones and Price (2001) discuss factors that impact on how existing knowledge is shared and how new knowledge is absorbed and transferred to become part of the firm's core knowledge competency.
- Ke et al. (2003) analyze the organizational learning process in ERP implementations. They propose that ERP implementation is a process of organizational strategic renewal.
- Ko et al. (2005) examine the antecedents of Knowledge Transfer from Consultants to Clients in ERP system implementations.
- Lee and Myers (2004c) suggest the theory of organizational defensive routines for understanding how organizational learning may be hindered during the implementation of ERP systems.
- Lim et al. (2005) from the knowledge perspective, the strategic use of an ERP system is posited to be dependent on symmetrical knowledge transfusion between the best practices embedded in the system and the existing procedural routines of the adopting organization.
- Lorenzo et al. (2005) identify and describe the process and key actions associated with the diffusion of ERP systems. This new perspective puts more emphasis on the importance of experiential learning.
- Newell et al. (2002b) analyze how social capital facilitates or inhibits knowledge integration and they explore how social capital is used during different episodes in the ERP innovation process.
- Newell et al. (2003) examine the simultaneous implementation within a single organization of an ERP system and a Knowledge Management system, two outcomes which traditional organizational theory suggests that are incompatible.
- Newell et al. (2004) suggest that in understanding the relationship between social capital and knowledge integration within a project team, it is necessary to distinguish between two forms of social capital: external bridging social capital and internal bonding social capital.
- Peters (2002) analyzes the implementation of an ERP system in a hospital, develops a model explaining the reasons for the problems, and suggests another approach using a multi layer agent system to support the knowledge intensive processes.

- Robey et al. (2002) adopt a process theory perspective with focus on the dialects of organizational learning that generates change in a comparative case study of 13 industrial firms.
- Sathish et al. (2004) present an overview of why stakeholders and their domain knowledge are important to ERP projects.
- Sedera et al. (2003c) discuss the initial findings of a two-phased study that focuses on empirically assessing the impact of knowledge management on the success of ERP systems.
- Sedera et al. (2004b) analyze the impact of managing knowledge on ERP systems success and study the relative importance of the knowledge management process.
- Sedera and Dey (2005) propose a theoretical model to identify the KM enablers and KM strategies of a rapid ERP implementation that facilitate knowledge creation, retention, and transfer and to determine the importance of knowledge transfer modes in a rapid ERP implementation.
- Stijn and Wensley (2001) introduce the organizational memory mis-match approach to analyze the process knowledge mismatches in ERP implementation and use phases.
- Timbrell et al. (2001) discuss impediments to knowledge transfer and present findings from the a posteriori application of Szulanski's model.
- Volkoff et al. (2004) identify the critical barriers and empirically uncover two new knowledge transfer mechanisms that are effective for addressing the knowledge transfer barriers in the ERP context.
- Wan et al. (2001) evaluate and critique the existing ERP implementation literature and then provide an alternative analysis of ERP implementation based on the concept of knowledge integration which involves the on-going interaction cross-functionally between organizational members.
- Wyssusek (2005) conceptualizes ERP as symbolic systems and examines ERP implementations in terms of semiotic and linguistic categories.

Other implementation issues

This topic encompasses other issues not covered in the rest of topics such as: role of consultants, applied theories to specific ERP issues, general conclusions and organizational change management in ERP projects.

- Aries et al. (2002) examine adequate computational performance dictated by the organization business processes and scalability that need to be satisfied by enterprise systems such as ERP and they propose some solutions based on their experience in the Boeing Company.
- Bokovec and Damij (2003) analyze the most important elements of a globally designed financial and management accounting model and their 'translation' to the structures and processes of an ERP system implementation.
- Duplaga and Astani (2003) survey 30 manufacturing firms to identify general trends related to several ERP implementation issues.
- Francalanci (2001) redefines the concepts of size and complexity for ERP projects and empirically verifies their impact on implementation effort.
- Huang and Palvia (2001) identify a range of issues concerning ERP implementations by making a comparison of advanced and developing countries.
- Murphy and Simon (2001, 2002) demonstrate how benefits analysis methods can be applied to large-scale ERP projects cost and that these methods can incorporate intangible benefits.
- Olhager and Selldin (2003) present the results of a survey of ERP implementations in Swedish manufacturing companies.
- Smagalla (2003) evidences that ERP software packages may drive improvement, but may not reconcile operational disparities.

- Tsai et al. (2004) using a survey of Taiwanese firms investigate the extent to which ERP systems were applied in manufacturing and service firms, and the major benefits obtained from the ERP implementation.
- Tu (2004) discusses related configuration security weakness in SAP system and suggests practical solutions to enhance the security control of SAP to comply with Sarbanes-Oxley act.
- Wright and Wright (2002) analyze the unique risks associated with ERP implementation projects for consideration in providing IS assurance services.

Main Topics Researched

Some authors have studied implementation approaches and have proposed some new ones. Requirements analysis, business modeling techniques, and reengineering have also emerged as important topics on ERP implementation research. Some authors propose a method that matches an ERP functionality model and a business requirement model, while others investigate the role of governance in ERP systems implementations. As Esteves and Pastor (2001c) pointed out, there remains the debate concerning the concept of ERP implementation. However, it seems that there is a consensus for the definition of ERP implementation up to the Go Live of the ERP system.

There are diverse studies focusing on the best practices and integrative frameworks based on an extensive review of the critical success factors that contribute to success in the context of ERP implementations. The research on critical success factors has evolved and issues such as their relevance along the ERP implementation stages and the contextualization of critical success factors to some business sectors or countries have been addressed. Researchers have created frameworks that allow the estimation of the difficulties of an ERP implementation project and the definition of risk factors in ERP implementations. Also, they discuss how the same software system implementation can produce different results.

Some studies redefine the concepts of size and complexity for ERP projects and empirically verify their impact on implementation effort, identifying a range of issues concerning ERP implementation by making a comparison of advanced and developing countries.

We evidence the emergence of studies related to organizational issues and change management process in ERP implementations, analyzing the reasons for user resistance, recognizing related user behaviors and actions, and identifying effective strategies to manage these changes. In this topic, authors seek to assess the severity of misalignment between ERP features and organizational requirements, examining the best practices in ERP implementation and the differences between the structures embedded in the package and those embedded in the organization. Other studies explore the way ERP systems add structure to organizations, which result under varying conditions of task interdependence, complexity and level of worker autonomy.

Articles in the field of knowledge management (KM) introduce the organizational memory mismatch approach to analyze the process knowledge mismatches in ERP implementation and use phases. This theoretical model identifies the KM enablers and KM strategies of a rapid ERP implementation that facilitate knowledge creation, retention, and how new knowledge is absorbed and transferred to become part of the firm's core knowledge competency in order to determine the importance of knowledge transfer modes in a rapid ERP implementation.

Topics for further research

There is a lack of studies regarding the definition, usage, and adequacy of ERP methodologies for SME contexts.

As we mentioned above, critical success factors are quite well studied. However, we noted that their operationalization is not. There is a need to develop approaches to put in practice and manage the critical success factors identified in some studies. The development of techniques

and approaches for the control and monitorization of ERP implementation projects is an area to be improved. It is also important to relate critical success factors with implementation methodologies.

While the findings suggest that research on the identification of critical success factors has reached saturation point, there is little interest in risk factors for ERP implementation projects. There is a need for more in-depth case studies that document ERP implementations. Most of the case studies are exploratory and lack theoretical basis. Understanding ERP implementation from a stakeholder perspective is also still lacking. There is a need to understand the types of ERP implementation issues met by the different stakeholder groups. Moreover, it would be interesting to analyze the role played by each stakeholder and the activities each stakeholder should play, along with issues of power, authority, and empowerment.

Most authors still provide a vision of many failed ERP implementations based on references of 2000 or before. There are no studies that show the evolution of success and failure rates during recent years. Presumably, with the experience gained over these years it should have changed, and the trade press does provide some insights into this, but ERP researchers still transmit the idea of many failures. In the field of knowledge management there is a lack of case studies that describe a complete process in a local environment and also in an international roll-out multinational project. There is also a need to understand how companies are managing the knowledge management process, tools used, and so on. Finally, aspects such as contingency plans, training of end-users, and training of the IT/IS departments have yet to be studied.

USE AND MAINTENANCE

Use Benefits and Success

- Beretta (2002) analyzes the role of process-based performance measurement systems on the organizational integration of ERP systems.
- Boudreau (2003) proposes a causal model that reveals key factors leading to the construct of “quality of use”. The model suggests that the inclusion of factors relating to learning allows understanding better why “quality of use” may vary among individual users.
- Chand et al. (2004) report their findings on balanced scorecard applicability for assessing the business contributions of ERP systems.
- Chang and Gable (2002) analyze some benefits of ERP systems in Queensland government.
- Dorantes and Walz (2005) examine the impact of ERP investment on business value by comparing the reaction of investors to ERP investment announcements with senior managers’ perceptions (ex ante) about the net benefits of the ERP system after its implementation (ex post).
- Esteves (2005) proposes a research model to analyze the benefits of ERP systems, by using disconfirmation theory as a theoretical basis.
- Gable et al. (2002) examine barriers to benefits-realization from ERP systems to provide innovative perspective on strategic management of large-scale packaged software, on the extended virtual enterprise explicitly or implicitly deployed across the ERP life-cycle.
- Gable et al. (2003); Sedera et al. (2003a); Sedera and Gable (2004); Sedera et al. (2004a) propose a model to measure ERP systems success.
- Gattiker and Goodhue (2004) using organizational information processing theory (OIPT) suggest several factors that influence some of the ERP costs and benefits that organizations are experiencing.
- Gattiker and Goodhue (2005) present a model of the organizational impacts of ERP systems once the system has gone live and the “shake-out” phase has occurred.

- Gefen and Ragowsky (2005) examine associations between the business characteristics of manufacturing firms and their perceived benefits from ERP system investments.
- Gwillim et al. (2005) present the results that support the findings reported in the literature and contribute new insights into the political factors that discourage the undertaking of post-implementation reviews (PIRs) in organizations.
- Hawking et al. (2004) explore the barriers and benefits in ERP implementations as firms moved in second wave value propositions.
- Hedman and Borell (2003) present an artifact evaluation of ERP systems based on the Competing Values Model. The result of the evaluation is used to discuss the impact of ERP systems on organizations.
- Hess and Hightower (2002) use the Joshi's equity-implementation (E-I) model based upon equity theory for understanding user satisfaction with ERP systems.
- Hillam's and Edwards' (2001) stakeholder analysis appears to be an essential element of an evaluation study on an ERP.
- Hitt et al. (2002) explain the business impact of ERP implementation on a wide variety of performance measures and empirically test for the productivity and business performance effects of ERP on firms that adopted ERP versus those that did not.
- Kanthawongs and Kini (2003) explore ERP implementation and evaluation in a developing country by extending the adoption framework model proposed by Huang and Palvia (2001).
- Lee and Lee (2004) propose a conceptual framework to highlight the importance of the change management after firms implement ERP systems.
- Lorenzo (2001) shows the preliminary results of the human, contextual, and processual issues influencing the ERP-use that evolves in a virtuous continuous improvement cycle.
- Martin and Cheung (2005) suggest that improvements through business process re-engineering can still be achieved after the implementation of ERP systems.
- McNurlin (2001) comments that 34% of the organizations were very satisfied with ERP, 58% were somewhat satisfied, 7% were somewhat unsatisfied, and 1% was unsatisfied. There are three critical success factors: successful user training and change management; effective handling of the risks and the fundamentals of project management; and continued executive commitment. The third item was the most crucial.
- Mendoza et al. (2005) examine the process of appropriation of application software over time to gain a deeper understanding of the influences that encourage productive and persistent use.
- Murphy and Chang (2002) examine and extend the social network theory to understand the impact of ERP systems on organizational function.
- Ranganathan and Samarah (2001) examine the impacts of ERP systems on firm value using the event study approach. The results show that investors view ERP systems as being productive and resulting in firm value.
- Saccol et al. (2003) evaluate the impact of ERP systems on organizational strategic variables of those companies using a survey to Brazilian companies.
- Scott (2005) analyze data on users perceptions of ERP training manuals, more than two years post-implementation, taking into account usability dimensions of task support, learn ability, navigation, and presentation.
- Sedera et al. (2001) analyzes ERP systems benefits realization approach of the Queensland Government using Balanced Scorecard.
- Sedera et al. (2002) discuss initial findings from a study that focuses on identifying and assessing important ERP impacts in 23 Australian public sector organizations.
- Sedera et al. (2003b) study the proposition that the size of an organization (e.g. small, large) may have contributed to the differences in receiving benefits reported in prior studies in this domain.

- Sedera et al. (2003d) illustrate key validity and reliability issues in measuring Information Systems performance using examples from a study designed to assess ERP systems success.
- Sedera and Tan (2005) attempt to clarify the controversy over the measures of user satisfaction and the adequacy of user satisfaction measures to gauge the level of success in complex, contemporary IS.
- Shang and Seddon (2002) propose an ERP benefit framework for summarizing benefits in the use of ERP systems.
- Shang and Seddon (2004) distinguish ERP from traditional information systems and forms propositions about ERP benefit assessment.
- Smyth (2001b) seeks to understand and explain ERP success through a process of empirical fact finding and analysis, supported by critical evaluation of established theory in related areas.
- Somers and Nelson (2003) conceptualize the fit of ERP systems in manufacturing organizations by conducting a study to identify how well organizational strategies and integrating mechanisms fit management's expectations of the system's value.
- Sousa and Goodhue (2003) propose a model to understand the exploratory use of ERP systems.
- Staehr et al. (2002a, 2003); Barnden (2003)] seek to understand and explain what business benefits have been obtained in the ERP post implementation period, and how and why these business benefits have evolved over time.
- Staehr et al. (2002b) examine ERP post implementation period in an Australian manufacturing organization with the aim of understanding and explaining the business consequences that occurred.
- Stein et al. (2003) examine the expected and actual benefits of current implementations and assesses the ROI of these implementations.
- Talbert (2002) discusses the importance of a long-term perspective for achieving business benefits from ERP systems.
- Voordijk et al. (2005) analyze the changing role of information technology in large engineering consultancy firms in the Netherlands after implementing ERP.
- Wu et al. (2002) examine factors relate to user satisfaction in Taiwan and compare satisfaction differences between enterprises implementing foreign and domestic ERP systems.

Maintenance

- Babaian et al. (2004) use collaboration theory to conceptualize the relationship between the user and the ERP system and to provide a foundation on which interfaces can be developed that enhance user performance and satisfaction with ERP systems.
- Bryson and Sullivan (2002) present an approach to analyze incentives schemes and structuring ERP outsourcing contracts for the mutual gain of the parties.
- Dibbern et al. (2002) based on a review of the IS outsourcing literature, present the knowledge-related determinants for the IS outsourcing decision, aggregating them in a structural model.
- Dorp et al. (2001) focus particularly on tracking and tracing in semi-process industry. Tracking and tracing enables ERP customers to optimize process performance with respect to recall management and may also offer better protection against product liability.
- Ingvaldsen et al. (2005) present an approach and a tool to business flow analysis that helps us reveal the real business flows. Analyzing the logs of large ERP systems, the tool reconstructs models of how people work and detects important performance indicators.
- Jones et al. (2004) using a theoretical framework explain the motivation for the development of shadow systems within an ERP context.

- Laframboise (2002) studies the effect of different levels of quality initiatives on business performance. The relationship between a firm's use of ERP systems and performance excellence was examined.
- Mookerjee (2005) takes a holistic approach to the problem of maintaining integrated systems such as ERP by considering it from three different perspectives: operational, architectural, and organizational.
- Nah et al. (2001a) identify maintenance activities pertaining to ERP implementation, classify them into maintenance categories, and assess their relative frequency at various stages of the ERP maintenance lifecycle.
- Pui Ng (2001) identifies the fundamental factors driving ERP maintenance and upgrade decisions.
- Pui Ng et al. (2003a) propose a preliminary ERP maintenance model reflecting fundamental ERP maintenance and upgrade activities.
- Pui Ng et al. (2003b) describe a case study of a large government agency to gather empirical data on their ERP maintenance model, from software maintenance preparation through software upgrade.
- Rattanasampan and Kim (2002) categorize selected theories of technology acceptance and use into four categories based on two dimensions: organizational/individual levels and the extent of voluntarism/determinism in technology acceptance and discuss some implications of each of these categories.
- Stratman and Roth (2002a) define and operationalize eight ERP competence constructs using a two-stage normative process of scale development.
- Stratman and Roth (2002b) analyze how the eight ERP competencies constructs act to influence business performance on North American manufacturing firms.
- Tanigawa (2004) seeks to understand architectural decision-making processes in practice from the descriptive view.
- Topi et al. (2005) categorize and describe the usability issues encountered by one division of a Fortune 500 company in the first years of its large-scale ERP implementation.
- Volkoff et al. (2005) analyze integration in the ERP context by discovering the salient characteristics or dimensions of ERP-enabled integration.
- Whang et al. (2003) propose a conceptual framework of ERP implementation process and identify the critical issues and factors for the successful upgrade of packaged ERP solutions.
- Wu et al. (2004) examine a small sample of actual outsourcing ERP contracts in several industries and a review of the relevant outsourcing literature. They determine the common provisions and structural characteristics of these ERP contracts.

Main Topics Researched

The main issues researched in this phase are post-ERP implementation benefits, limitations, and factors that affect ERP usage. It is important to assess the ROI of these implementations and compare the reaction of investors to ERP investment announcements with senior manager perceptions about the net benefits of the ERP system after implementation. However, the size of an organization may contribute to the differences in perceived benefits. Some studies analyze the impact of ERP systems on organizational strategic variables in firms that adopted ERP versus those that did not, examining and extending the social network theory. Generally, the relationship between the user and the ERP system will give a guide to interfaces that can be developed to enhance user performance and satisfaction with ERP systems. Most of the improvements through business process re-engineering can still be achieved after the implementation of ERP systems. Some authors propose a preliminary ERP maintenance model, reflecting fundamental ERP maintenance, and then to upgrade activities from three different perspectives: operational, architectural, and organizational. Recently, the issues of ERP outsourcing and maintenance models have gained importance. Researchers classify maintenance categories and assess their relative frequency at various stages of the ERP maintenance lifecycle.

Topics for Further Research

Although, there are some studies on ERP benefits, few studies have looked at the post-implementation period of ERP systems to determine how and why business benefits evolve over time.

There is also a need to study the level of integration of ERP systems in organizations. It would be interesting to define critical success factors for the usage and maintenance phase. User satisfaction and human factors affecting this satisfaction should be studied. Usability is also an important topic and probably the field of human-computer interaction can help in this analysis. The way organizations create and manage knowledge related to their ERP systems and the usage of knowledge theory on this subject would be a topic for valuable research. Regarding ERP maintenance, other open issues are: outsourcing services, maintenance models and techniques, costs and benefits models, service level agreements, improvement of ERP maintenance based in previous bespoke maintenance, and management of upgrades and their impact. Most international companies are negotiating maintenance contracts on a global scale. Issues such as the upgrade and new versions in a global environment must be addressed. For instance, there is a need to understand the question of local versus remote support and associated cultural issues. End-users are a critical success factor and few studies analyzed their adaptation and the role they perform in ERP usage. There is a need to analyze issues such as training, participation, skills, and abilities that are required to ensure the success in use and maintenance of an ERP system.

EVOLUTION PHASE

Some authors analyze new emerging ERP technologies and new business models.

Emerging Technologies

- Akkermans et al, (2003) present the results from a Delphi study on the future impact of ERP systems on supply chain management.
- Alaranta (2005) studies the post-merger integration of ERP systems by testing the Motwani et al. (2002) framework for ERP Implementation that is based on Business Process Change Theory in this context.
- Ash and Burn (2001a) report on a longitudinal study of e-business change management in ERP enabled organizations.
- Ash and Burn (2001b) examine a research model that proposes various antecedents to successful e-business change management in ERP environments.
- Ash and Burn (2002a) analyzed a case study of e-business evolution using a staged implementation which allowed to evaluate it in terms of the attributes of the “virtual organizing” model.
- Ash and Burn (2002b) report on research carried out from 1999-2001 on the use of e-business applications in SAP based organizations. They try to demonstrate the increased benefits derived from an e-business architecture based on a network of ERP enabled organizations.
- Ash and Burn (2003) use the previous e-business change framework to evaluate the mature stage of e-ERP in six international organizations.
- Bendoly (2003) provides an extension to the theory for process frameworks in knowledge discovery and data mining from ERP systems.
- Bendoly and Kaefer (2004) show that perceived transactional efficiencies are greater for B2B e-commerce technologies in the presence of ERP and are, in fact, magnified when ERP implementation specifically precedes B2B e-commerce initiatives. These findings imply a distinct system adoption strategy for firms pursuing e-commerce opportunities.
- Birbeck and Stewart (2004) investigate the relationship between organizational culture and IT innovation success in the context of extended ES.

- Bornhövd et al. (2005) give an overview of the existing SAP's Auto-ID infrastructure that enables the integration of RFID and sensor technologies with existing business processes.
- Burn and Ash (2002a) use an established research framework of e-business change to identify the factors for success of an e-business project within an ERP environment.
- Burn and Ash (2002b) report on research carried out in 1999-2001 on the use of e-business applications in ERP-based organizations.
- Cheung et al. (2001) found that the success of the e-commerce infrastructure in the GlobalMNC lies in the underlying knowledge architectural design.
- Gable et al. (2001) explored the present and future relationship of ERP and E-business software and their respective futures.
- Gefen and Ridings (2002) examine the social aspects of CRM implementation by using a quasi-experimental design.
- Hawking and Stein (2003) analyze the skills needed to move into e-business and e-commerce based in a survey to IS professionals working with ERP systems.
- Haro and Peterson (2004) explain how and why customer enterprise strategies and systems co-evolve and influence organizational performance.
- Holsapple and Sena (2005) examine relationships between the importance of various objectives in ERP planning and the subsequent realization of decision support benefits from an ERP system.
- Huang et al. (2001b) consider the complementary implementation of ERP and KM systems in a particular company. These systems can aid organizational efficiency and flexibility.
- Hung et al. (2004a) construct a conceptual model to evaluate the performance and competitive advantages associated with ERP from a SCM perspective.
- Hwang and Leitch (2003) develop and illustrate a Balanced Scorecard control framework for the assessment of ERP/e-commerce system implementations.
- Jaiswal and Kaushik (2005) describe how Business Network Systems (BNS) can be redesigned using ERP systems to strengthen relationships with business partners and to enhance value to consumers.
- Lee and Shu (2003) Failure to understand that the complementarity between technology and organizational may cause low payoff of IT investment. This study proposes to combine the American Customer Satisfaction Index (ACSI) model and complementarity framework to provide optimal design and adoption of CRM software.
- MacGregor et al. (2003) analyze the role of enterprise-wide business systems in the adoption and use of e-commerce in Swedish SMEs.
- Metaxiotis et al. (2003) examine the lack of support of ERP systems in the production-scheduling process. Therefore, they propose a knowledge-based system for production that could be incorporated as an ERP custom module.
- Moon and Bahl (2005) present a simulation study to evaluate the impact of the Manufacturing Execution Systems (MES) integration with the ERP system on production lead times.
- Parsons (2005) focuses on the issues of distributed ERP architectures where objects are able to run on mobile devices, but must be universally synchronized.
- Rauch (2002) focuses Supply Chain Process as an enterprise Application.
- Sammon et al. (2003a) analyze the re-emergence of data warehousing to address the limitations and unrealized benefits of ERP systems.
- Sammon et al. (2003b) find the re-emergence of Data Warehousing to address the limitations and unrealized benefits of ERP systems implementation provides researchers with a new challenge in understanding the 'double learning curve' for an organization.
- Sammon et al. (2004) attempt to understand organizations needs discourse and to identify if ERP II is positioned to address these needs.

- Sasovova et al. (2001) examine limitations that restrict the potential benefits from the use of ERP systems in business firms.
- Singletary et al. (2003) present a qualitative research study to surface practitioner interpretations (assumptions, knowledge, and expectations) of enterprise Application Integration (EAI).
- Stirling et al. (2002) propose a methodology for the structured development of manufacturing information systems, taking as a premise the existence of a core ERP system.
- Wagner and Bergin (2001) identify the shortcomings of today's ERP systems with respect to strategic planning and demonstrate the application focus and functionality of the new Enterprise Strategy Management (ESM) systems, mapping them against a four phase model of strategy management.
- Wieder et al. (2002) discuss Information Systems Quality and ERP from a point of view of value and integration.

Integration Issues

- Esichaikul and Nuankhie, (2004) provide a framework assisting ERP adopters in the selection of the integration approach more appropriate to their needs.
- Grant and Tu (2005) propose a conceptual framework for better understanding of ERP integration issues based on existing literature.
- Hwang (2004) discusses issues that are important to the integration of ERP systems in a merger and acquisition environment.
- Irani et al. (2003) analyze the impact of EAI on Information Systems lifecycles and they propose an EAI classification framework.
- Khoubati et al. (2005) present the advantages and disadvantages of integration technologies that promise real time ERP systems integration.
- Lee et al. (2003) look at ERP and EAI and investigate their values for today's organizations. They present and compare two different approaches: internalization, represented by ERP; and externalization, through the use of EAI.
- Lee and Myers (2004a) suggest that enterprise integration is not inevitable, nor is it always strategically necessary.
- Ndede-Amadi (2004) examines the transition from strategic alignment as the basis for IT investment to BPR, and to the integration of these processes into enterprise-wide systems to e-commerce.
- Pellerin (2005) addresses specifically the defense maintenance management functions that need to be integrated into an ERP solution by adopting the view of a defense repair and overhaul facility.
- Reiersgaard et al. (2005) propose an initial framework for the EAI implementation process. The revised framework identifies ten new factors based on the findings from the case study which affect core business process integration by EAI.
- Sammon and Adam (2004) lay the foundation for a model of organizational prerequisites for enterprise-wide integration projects. The main objective of the paper is to present a literature-based model which lists the key prerequisites organizations should assess prior to undertaking these expensive projects.
- Scheer et al. (2002) propose an interface classification using the internet in supply chain networks.
- Shafiei and Sundaram (2004) propose a framework that brings together ERP and DSS and explains the mechanisms to integrate ERP and DSS at enterprise and cross-enterprise level.
- Sharif and Irani (2005) highlight the emergence of componentization, an extension of ERP functionalities (i.e. so-called ERP II) in terms of a failed ERP-led and EAI implementation within an industrial products organization.
- Sharif et al. (2005) analyze and extend previously published work through presenting the failure of an industrial automation business to integrate its ERP system with legacy processes when using an EAI approach.

- Themistocleous et al. (2001a, 2001b) present a survey that identifies ERP problems and the use of EAI solutions in order to solve ERP integration problems.
- Themistocleous et al. (2002) explain why ERP systems have failed to support integrated supply chains and introduce in a new approach on systems integration.
- Themistocleous and Irani (2003a) extend previous work on EAI by proposing a novel evaluation framework for the assessment of EAI packages.
- Themistocleous and Irani (2003b) propose a model for the adoption of application integration. The model suggests that various factors such as benefits, barriers, costs, external pressures, and others influence the adoption of EAI.
- Themistocleous et al. (2004) investigate the role of EAI solutions in an organization and their findings indicate that EAI adoption reduces the operating costs, as well as, the redundancy of data and functionality in the studied organization.
- Tiako (2005) focuses on Data Integration Issues for Business Intelligence Integrated Enterprise Information Systems.

Main Topics Researched

The issues studied here have also been mainly technology-oriented, such as development of interfaces with other systems, the emergence of componentization and extension of ERP functionalities, the integration of customer relationship management modules, and the usage of web technologies. Another important issue studied is workflow management with proposals for new approaches and architectures.

Some researchers analyze the impact of EAI on information systems lifecycles and propose an EAI classification framework, identifying ERP problems and using EAI solutions to solve ERP integration problems. Hence, EAI adoption reduces the operating costs, as well as, the redundancy of data and functionality in the studied organization. Also, some studies show the advantages and disadvantages of integration technologies that promise the real time ERP systems integration and suggest that integration is not inevitable, neither is it always strategically necessary.

Other studies analyze the skills needed to move into e-business and e-commerce based on a survey of IS professionals working with ERP systems. Some studies emphasize that perceived transactional efficiencies are greater for B2B e-commerce technologies in the presence of ERP. They are, in fact, magnified when ERP implementation specifically precedes B2B e-commerce initiatives. Finally, the re-emergence of Data Warehousing, to address the limitations and unrealized benefits of ERP systems implementation, brings researchers the new challenge of understanding what is effectively a 'double learning curve for an organization.

Topics for Further Research

There is a need to analyze when an organization should go for emerging ERP capabilities and how to integrate them in the overall IS. It is also important to analyze the organizational perspective and understand the impact of these emerging capabilities in organizations. Although the relationship between ERP and SCM has been studied to some extent, a considerable amount of research still needs to be conducted in order to make it easier for client companies and software vendors to assist in developing an integrated SCM.

We should point out that we also found that most of the conferences are creating special tracks dedicated to these new topics, which are usually independent of ERP issues. Therefore, the number of articles in this category is probably higher than the one presented here. We think that in the future there will be a need to analyze the relationship between these new research topics and the ERP systems that are used as a basis in any organization to develop these new technologies.

Lately, most ERP vendors are creating ways to use mobile technology to expand the creation and share of data in ERP systems. Lots of companies are using these tools. On-demand and open-source ERP software are also emerging as new trends in ERP arena.

RETIREMENT PHASE

We did not find any publication related to this phase, but some publications cited some cases of ERP systems retirement for various reasons. Some publications appeared in the press [e.g. *New York Times*, *Wall Street Journal*, *the Economist*] relating some ERP implementation disasters. Now, the majority of organizations are in the implementation or in the use and maintenance phases. We expect that in the future these cases will be analyzed in more detail. However, we found some studies about ERP failure implementations (see implementation phase above).

Topics for Further Research

This phase is doubtlessly the least studied. When, why, and how an organization abandons ERPs is an important issue. Some cases of system failure have been reported; however, no author has defined what is meant exactly by ERP system failure neither has anyone identified the most significant factors in the failure of these ERP projects. Another issue that has not been addressed is the definition of the expected useful life span of an ERP. It would be interesting to analyze how the retirement of an ERP system affects the organization. Moreover, it would be interesting to understand what is the organizational impact of the decision to abandon an ERP system.

V. ERP AND EDUCATION

The interest on ERP systems by universities is evidenced by the number of publications published as shown in Figure 3. Universities analyzed the use of ERP in education, ERP courses, and how to change the IS curricula to incorporate ERP systems.

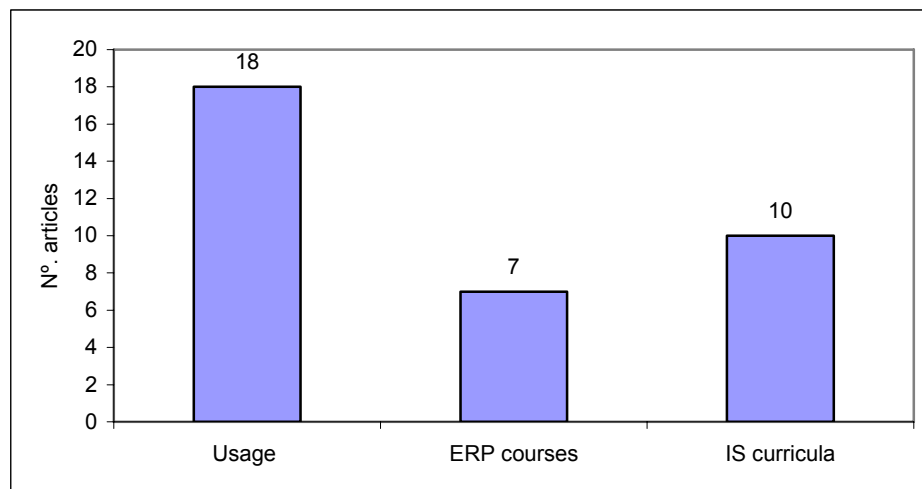


Figure 3. Number of publications related with ERP and education.

ERP USAGE BY UNIVERSITIES

This topic focuses on the processes and mechanisms that some universities are using to gradually introduce ERP system in their education process and sometimes the adoption of and ERP system by the universities.

- Allen and Kern (2001) analyze ERP implementations in higher education institutions focusing in power, politics, and resistance issues.
- Beekhuyzen et al. (2002) investigate the adoption of ERP systems by Australian universities.
- Bradley and Lee (2004) investigate the relationship between training satisfaction and the perceptions of ease of use, effectiveness, and efficiency in the implementation of an ERP system at a higher education institution.

- Dyke and Sinclair (2003) identify the factors that universities' staff perceives as contributing to the effective implementation of ERP systems in universities.
- Frantz et al. (2002) surveyed CFO's and CIO's of higher education institutions to analyze their perceptions of best practices for ERP implementations.
- Furumo and Pearson (2004) use Adaptive Structuration Theory and critical success factors to analyze an ERP implementation in two universities, determining why one failed and the other was successful.
- Morley and Hellens (2003) explore the quality issue of response times and the impact of poor response times on the ability of an Australian university to achieve their strategy within ERP implementation.
- Oliver and Romm (2002a) address the rationale for adoption of ERP systems in universities. This study is structured around the theory of motivations for investment in information technology (IT) to support core business operations.
- Pollock et al. (2003) investigate the development and implementation of an ERP module in a university. Based on an ethnographic study, they develop the notion that ERP systems have a 'biography' that helps to understand their evolution.
- Pollock and Cornford (2004) provides analysis of the rollout of an ERP system in a university in order to illustrate the value of taking discussions of similarity relationships surrounding the university and other organizations as the topic of analysis.
- Scott and Wagner (2003) analyze an ERP implementation in a university and they develop the theme of temporality within actor-network theory to support their analysis.
- Sehgal and Stewart (2004); Sehgal et al. (2004) investigate how user empowerment can impact the potential components of Enterprise System Success (ESS) and the employee's immediate work environment in a higher education institution.
- Suratmethakul and Hasan (2005) reveal details within complex phenomena in an organization when a substantial new system was implemented. The study revealed three critical issues: Knowledge Transfer, System Capability, and Organizational Context.
- Swartz and Orgill (2001) propose a framework for ERP adoption and implementation in universities.
- Tracy et al. (2001); Stewart et al. (2002) developed a simulated economic environment in which a virtual supply chain, based on the manufacturing and sales of personal computers, operates. The participating institutes of higher learning will be able to develop and deliver world-class, technology-enabled business and management education programs utilizing the mySAP.com e-business applications to their full extent.
- Wagner and Newell (2004) analyze the strategic partnership between a multinational software vendor and a university who together designed a 'best practice' ERP package for the higher education industry.

ERP COURSES

This topic describes the different types of ERP courses offered by several universities and some ERP courses proposals.

- Antonucci and Muehlen (2001) present a description of the collaboration and the preliminary evaluation results, in the form of students' feedback, of an international collaboration between two universities that address these issues of new e-centric business practices. The collaboration deploys a case scenario methodology that utilizes SAP R/3 and the web to link geographically dispersed students.
- Hawking et al. (2001) outline how ERP systems can be incorporated into a broad IS curriculum model such as IS'97 curriculum.

- McCarthy and Hawking (2004) argue that a blended approach to Enterprise Resource Planning education which incorporates both classroom based education and e-learning is the preferred option.
- Nelson and Millet (2001) provide the rationale, educational objectives, and content design for a foundation course in ERP and Business Processes. They also describe educational outcomes as measured by changes in students' self-reported levels of knowledge before and after the course.
- Nelson (2002) describes a workshop that prepares instructors to teach an ERP and business processes course using SAP technology.
- Stewart and Rosemann (2001) discuss the design of a problem-based learning approach that seeks to embed industrial knowledge in the ERP related curriculum of universities.
- Tan and Richardson (2005) discuss whether software meets the needs and expectations of the students sufficiently and whether computer experience, in particular the number of computer courses previously studied, was found to influence both perceived ease of use and usefulness of Mind Your Own Business (MYOB) when used in a first year accounting course.

IS CURRICULA

This topic is related with the integration of ERP system in IS curricula, the need of people with ERP knowledge, and how universities can improve and re-structure their curricula in order to satisfy the needs.

- Beekhuyzen and Gasston (2002) explore how universities can benefit from understanding and fully utilizing their knowledge management activities to improve its curricula using knowledge that exists within the ERP environment.
- Bradford et al. (2003) based on a survey at 94 colleges and universities examine some issues related with ERP integration in the classroom such as: the reasons why schools did not adopt ERP for teaching purposes, implementation issues, and pedagogical uses.
- Hawking and McCarthy (2001) describe the issues and barriers associated with integrating ERP systems into university curricula.
- Hawking et al. (2005) discuss the evolution of ERP systems and how universities are attempting to develop their curriculum to complement these changes. They identify how one university is addressing this dilemma and how this approach could be adopted and expanded further.
- James and Too (2005) report, in terms of an action research framework (ARF), an ongoing project to facilitate the evolution of the approach to teaching an IS final year undergraduate and postgraduate subject, from a conventional content-focused approach to one that guides students through a process of reflection-in-action by means of assessable milestones.
- Joy and McCarthy (2002) discuss expansion of the Application Service Provision (ASP) market to deliver ERP applications and curriculum to educational institutions offshore.
- Rosemann (2002) provides a structure to ERP education issue that helps academics distinguish among different approaches for the integration of these software packages into their curriculum.
- Stewart et al. (2004) detail the curriculum innovation in a project focused on engaging students in learning ICT. They report the progress of the project and its application to enterprise systems area.
- Strong et al. (2005) present a panel designed to contribute to the ability of many more universities to provide a stimulating ERP-based educational environment for students.

- Theling and Loos (2005) describe how a market-leading ERP system can be used to demonstrate theoretical knowledge of ERP systems. They propose an integrative ERP curriculum which maps different theoretical IT-knowledge to ERP systems.

MAIN TOPICS RESEARCHED

The analysis of IS curricula is quite well covered in research studies, as is the response of universities to the demand for people with ERP knowledge. Some ERP courses are explained in detail. However, their importance in relation to the ERP market is not. Studies of ERP adoption and usage by universities are very useful for other universities that are in the process of adopting an ERP system.

Some authors investigate the development and implementation of an ERP module in a university. They investigate the relationship between training satisfaction and the perceptions of ease of use, effectiveness, and efficiency in the implementation of an ERP system at a higher education institution. Other authors analyze the strategic partnership between a multinational software vendor and a university who together designed a 'best practice' ERP package for the higher education industry.

In ERP courses, authors provide the rationale, educational objectives, and content design of courses, taking into account the students' feedback. They also discuss the design of a problem-based learning approach that seeks to embed industrial knowledge in the ERP-related curriculum of universities. Some researchers argue that a blended approach to ERP education which incorporates both classroom based education and e-learning is the preferred option.

Some studies refer to IS as a curriculum subject, examining some of the issues related with ERP integration in the classroom such as: the reasons why schools did not adopt ERP for teaching purposes, implementation issues, and pedagogical uses. They also describe the issues and barriers associated with integrating ERP systems into university curricula. Finally, some studies discuss the evolution of ERP systems and how universities are attempting to develop their curriculum to complement these changes.

TOPICS FOR FURTHER RESEARCH

An important issue is how universities are dealing with ERP evolution and how they are planning their courses and adapting them to this evolution. Another issue is ERP market satisfaction among people that acquire ERP academic knowledge. In relation with ERP adoption and usage by universities, studies related with all the phases of the ERP lifecycle should now be undertaken. In general, there is certain confusion about use of the term ERP in relation to other information systems. Small vendors use the term ERP for systems that have an accounting package, whereas large vendors (SAP and Oracle) keep adding modules and abbreviations (SCM, CRM, etc.) to their traditional ERPs. Educational establishments have to differentiate and participate, through research, in new definitions that are emerging in the market.

VI. CONCLUSIONS

Although Esteves and Pastor (2001c) thought that the number of publications on ERP systems would grow exponentially after 2001 because many universities had created research areas in ERP systems and the interest of the IS community was growing as well, the number of publications in the upcoming years did not evolve thus.

Publications within the information systems community on ERP systems are scant compared to the business that they have generated. The publications identified in this paper originate from a small number of sources and only recently. All major IS conferences have dedicated a track or mini-track to ERP systems. In fact, conferences are still the main source of publications while journal publications are few in number. This is especially evident in top journals, which have offered very few publications over the last five years. Also, in some journals, most ERP

publications appear in special issues and not on a regular basis. We also noted that some conferences are creating mini-tracks dedicated to specific modules of extended ERP systems such as CRM and SCM, and that seems the most likely trend to develop over the next few years.

This study shows that ERP researchers still focus on the implementation phase of the ERP lifecycle. The other phases are starting to gain importance, however, especially the usage and evolution phases. One of the reasons is that the majority of mid-sized and large organizations have already implemented an ERP system. With ERP vendors approaching SMEs, the findings of this study suggest a lack of research on this market and type of companies. Although there are several ERP systems in the market, the majority of case studies analyzed still center on SAP systems. There is evidence of a lack of studies and research generalization of findings to other ERP systems.

Although some researchers have started analyzing the problem of mergers and acquisitions among ERP vendors, such as Oracle, Peoplesoft, JDEdwards, and among companies with different ERP systems, there is a need to focus more on this issue.

Overall, we found evidence of a lack of comparative studies. Despite the profound and often paradoxical implications of applying some theories to the ERP field, the study of ERP systems still suffers from a lack of systematic comparative research among organizations, industrial sectors, and geographic regions.

Again, we think that ERP systems offer many potential areas for research, several of which were discussed in this paper. Due to their pervasive nature, ERP systems are of interest for a wide range of professional and scholarly communities (from software engineering to accounting), and not only the field of IS. This suggests that ERP-related research could or should be interdisciplinary.

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